

Project Status Updates

Note: This document contains brief descriptions of the status of projects undertaken by WWA team members. Most of these projects are near their midpoints, although some are just beginning. If you are interested a specific project, contact information for individual researchers is available at the bottom of each description. For general inquiries about Western Water Assessment, please contact Program Manager Eric Gordon at eric.gordon@noaa.gov.

Theme 1: Decision Support for the Colorado River Basin and Headwaters

Impacts of Coupled Climate Change and Dust Deposition on Water Resources in the Colorado River Basin

In September, *Proceedings of the National Academy of Sciences* published “Response of Colorado River Runoff to Dust Radiative Forcing in Snow,” a summary of work by WWA researchers and others on the impacts of dust on snowpack in the Colorado River Basin. This research showed that dust deposition is not only causing early spring runoff but also may be responsible for evaporative losses equivalent to nearly 5 percent of the total river flow. WWA researchers are currently updating the study to incorporate data from 2009 and 2010, and are also working to incorporate future climate projections.

Contact: Jeff Deems, WWA and National Snow and Ice Data Center (NSIDC), jeffrey.deems@noaa.gov

Paleohydrology of the Lower Colorado River Basin

The objective of this project is to facilitate system modeling of the entire Colorado River Basin under a wider range of hydrologic variability, by generating multi-century tree-ring reconstructions of streamflow for the Lower Basin commensurate with reconstructions that have already been developed for the Upper Basin (at Lees Ferry). The project commenced in late September 2010 with a meeting of the research team in Boulder. Lisa Wade is currently working to estimate the post-1900 natural flows for the Gila River, the mainstem Lower Colorado River, and their tributaries, to use to calibrate tree-ring reconstruction models. The team is led by Balaji Rajagopalan and Jeff Lukas and includes researchers from CSU and the University of Arizona. In addition to WWA, the funding for the project comes from the Colorado Water Institute at CSU and the Colorado River District.

Contact: Jeff Lukas, WWA, lukas@colorado.edu



Stochastic Streamflow Simulation at Interannual and Interdecadal Time Scales and Implications to Water Resources Management in the Colorado River Basin

Ken Nowak continues to work on decadal variability in Colorado River streamflow to produce stochastic projections that will ultimately be used to guide reservoir operations in the basin. Soon he will test the utility of these decadal projections using the Bureau of Reclamation's long-term planning model, CRSS. He recently submitted a paper to *Journal of Hydrology* on stochastic simulation of multisite streamflow with nonstationary spectral features which was demonstrated on the Colorado River Basin flows. Another paper, soon to be submitted to *Journal of Climate*, documents the climatic drivers of multidecadal variability of streamflow in the basin. Cameron Bracken, working on forecasting algorithms for seasonal flow, has completed work extending a disaggregation framework to all the natural flow nodes in the Upper basin. Work is also in progress on methods to predict out-year flows that exploit variability in the paleo streamflow record. In addition, development of the new probabilistic midterm operations model continues at CADSWES with help of a Reclamation consultant and CADSWES software team. This model will serve as the test bed for Cameron Bracken's new forecasting methods.

Contact: Balaji Rajagopalan, Civil Engineering, rajagopalan.balaji@colorado.edu

Theme 2: Ecological Vulnerabilities, Impacts, and Adaptation

A Toolkit for Adapting to Climate Change on Western National Forests: Incorporating Climate into Resource Management and Planning

This project is developing and evaluating decision support for natural resource management adaptation to climate change by conducting case studies on National Forests in the western United States. Research has already been completed for three National Forests in Washington and California. Current research on the Shoshone National Forest in Wyoming is focused on developing information and testing tools that will assist natural resource managers in the development of adaptation options for managing National Forests under a changing climate. Janine Rice has synthesized the current state of knowledge about climate and how future climate change may impact the ecosystems and aquatic systems of the Shoshone and Greater Yellowstone Ecosystem. She is in the initial stages of developing a vulnerability assessment tool for watersheds and vegetation where the sensitivity of these resources to climate and their exposure to climate change can be evaluated for specific areas within the Shoshone National Forest.

Contact: Janine Rice, WWA and US Forest Service, jrice02@fs.fed.us

Controls on pH and Ammonia Toxicity in Rivers of the Colorado Plains

In support of their work on pH and ammonia toxicity in Plains rivers, Jimmy McCutchan and his team began field studies on the South Platte River and Boulder



Creek in 2010. Laboratory analyses of samples collected through November 2010 are nearly complete, and flow modeling and data analyses are underway. Data collected in 2010 are being used in combination with historical data for 12 river stations, in order to develop quantitative relationships between temperature, river discharge and velocity, accrual of algal biomass, and pH. These relationships will provide a foundation in the future for mechanistic modeling of links between variation in climate or changes in flow management and water quality in Plains rivers.

*Contact: Jimmy McCutchan, CIRES Center for Limnology,
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Bark Beetles & Forest Change

WWA is currently working to help further research on water-related impacts of tree mortality due to widespread bark beetle infestations. Building on last year's efforts to coordinate research with stakeholder needs and synthesize research results, Eric Gordon has been working with Evan Pugh to develop a conceptual model of the impacts of beetle-induced tree death on hydrologic processes. Eric will present a poster on this effort at the upcoming American Geophysical Union (AGU) Annual Meeting, and Eric and Evan are working on a paper. Eric and Jeff Lukas also plan to organize a symposium on bark beetles and water in the spring of 2011 to follow up on a similar successful effort in April 2010.

Contact: Eric Gordon, WWA, eric.gordon@noaa.gov

Downscaled Precipitation Projections for Southwestern Colorado

WWA researchers Jason Neff, Karen Cozzetto, and Imtiaz Rangwala are examining 50-km resolution downscaled precipitation projections for southwestern Colorado that have been downscaled to a 50 km resolution. This information is being used for two purposes: 1) to evaluate how well historic projections are able to simulate current precipitation patterns at annual, seasonal, and monthly timescales and to do some preliminary diagnoses as to why certain simulations may or may not be better than others; and 2) to assess whether there is any consensus among the models as to what changes in precipitation can be expected in the future, both in terms of quantity and timing. This involves comparing future projections for the 2041-2070 time period with historic projections for the 1971-1999 time period. Ultimately the historic and future precipitation projections for six different RCM-GCM model combinations will be examined. Jason, Karen, and Imtiaz have analyzed data for five of them and are currently processing the data for the sixth RCM-GCM combination and for the NCEP-forced runs.

Contact: Karen Cozzetto, Department of Geological Sciences, kcozzetto@colorado.edu

Climate Change Impacts on Public Lands in the Upper Colorado River Basin

WWA researchers Jason Neff, Dan Fernandez, and Karen Cozzetto have produced a drought model that predicts which landscapes are more vulnerable to drought. The model works on the basis of 1-hectare resolution NRCS soil depth and texture data,



soil water retention parameters calculated with the USDA Rosetta program, spatially and temporally explicit evapotranspiration data, and spatially explicit vegetation community type max transpiration data. The researchers have run the model using gridded 25-km² daily precipitation data for the time period of 1948-1998 for the southwestern part of Colorado. Results show that precipitation most strongly predicts drought vulnerability followed by soil depth and soil texture; however, vegetation community type strongly interacts with precipitation, depth, and texture. Jason, Karen, and Dan plan on increasing the resolution to meaningfully include slope and aspect in the model and using higher resolution precipitation to drive the model. The final goal is to develop the model into a landscape drought vulnerability prediction tool.

Contact: Jason Neff, Department of Geological Sciences and WWA, neffjc@colorado.edu

Theme 3: Emerging Initiatives and Adaptation Strategies to Inform Climate Services

Energy-Water Nexus

In September 2010, WWA hosted a workshop of experts on energy and water to reconcile estimates of water requirements for energy technologies. The results will be reported in a forthcoming report, and will be presented in collaboration with NREL at the AGU meeting in December.

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Towards Frameworks for Climate Services

WWA, along with the Climate Assessment for the Southwest (CLIMAS) and the NWS Colorado Basin River Forecast Center (CBRFC), collaborated on a workshop held in Grand Junction in April 2010 that focused on a new CBRFC decision support tool. The workshop used computer-based training exercises and scenario games to guide the CBRFC developers in how to improve the tool. After the success in Colorado, future workshops are being planned for Utah, Oklahoma, and Georgia. More broadly, WWA is continuing to engage with NOAA and other federal partners to evaluate how we will best fit within the proposed National Climate Service.

Contact: Kristen Averyt, WWA, kristen.averyt@noaa.gov

Drought Adaptation Among Ranchers in the Intermountain West

Kristin Gangwer, working with Bill Travis, has been interviewing ranchers throughout the “Three Corners” region of Colorado, Utah, and Wyoming. Her interviews are helping paint a picture of ranchers’ perceptions of climate, along with their needs for climate information. This type of data is critical to understanding how to deliver climate services to a variety of stakeholders.

Contact: Bill Travis, Department of Geography and Center for Science and Technology Policy Research, wtravis@colorado.edu

WWA Core Activities

Developing and Formalizing Best Practices for Interpreting Temperature and Precipitation Time Series

The Utah Climate Center at Utah State University, in collaboration with the Colorado Climate Center at Colorado State University, the Western Water Assessment at the University of Colorado and the Cooperative Institute for Research in the Atmosphere in the CSU Department of Atmospheric Science, is developing a publication of findings and recommendations on best practices for developing and interpreting historic records and time series, specifically for temperature and precipitation records. This paper will document the process of selecting the best station records in Colorado and Utah. The goal is to make climate data from the instrumental record (late 1800s until the present) accessible to public audiences, decision makers and educators in a manner that the seasonality, interannual variability and long term trends can be easily visualized and accurately portrayed.

Contact: Rob Gillies, Utah Climate Center, Utah State University, gillies.robert@gmail.com

Redesign of WWA Website

Heather Glenn is working on an overall redesign of the WWA website to make it more user-friendly and highlight information relevant to WWA stakeholders. Feedback on the existing website and suggestions relevant to the content and structure of the new website would be greatly appreciated.

Contact: Heather Glenn, WWA, heather.glenn@noaa.gov

WWA Work in Support of the National Climate Assessment

Colorado Climate Preparedness Project

The Colorado Climate Preparedness project is intended to providing an overview of current and planned adaptation-related activities undertaken by state agencies and other entities in Colorado. The project team has completed 23 interviews for five sectors (water, energy, wildlife/ecosystems/forests, outdoor recreation, and agriculture) and is currently drafting the final report. A database of relevant people, projects, products, and organizations has been populated and is undergoing final review before it becomes publicly accessible. The final deliverables will be completed in January 2011.

Contact: Bobbie Klein, Center for Science and Technology Policy Research, roberta.klein@colorado.edu

New Social Science Initiatives

The Challenge of Accounting for Climate Change in Assessing the Environmental Impacts of Federal Actions in the Intermountain West

Mark Squillace and Alex Hood have begun a new project intended to provide federal agencies with additional guidance on incorporating climate change into NEPA documents. Mark and Alex have completed a draft introduction, which offers a detailed description of the project and tentative goals for the project. They intend to provide a copy of the Introduction to those parties whom we plan to interview and have begun to develop a list of such parties and will be conducting interviews over the next several months. In addition, the Introduction will guide further research and other work associated with the project. As they carry out this work, the Introduction will evolve to reflect the new information and ideas that are gleaned from the interviews and other research.

Contact: Mark Squillace, Natural Resources Law Center, mark.squillace@colorado.edu

Regional Integration Among M&I Water Providers: Lessons in Climate Adaptation and Risk Management for Colorado's Front Range

The objectives of this new project are to understand how regional integration among water providers affects adaptation to climate variability and change. Researchers Kenney and Cody are examining case studies in California and Nevada to look for potential lessons applicable to Colorado's Front Range. The project also entails a literature review of climate change adaptation, natural hazards, risk, and water/drought management.

Contact: Doug Kenney, Natural Resources Law Center, douglas.kenney@colorado.edu

Climate-Related Decision Making on Public Lands in the Mountain West

The objectives of this new research project are threefold: 1) to quantitatively assess awareness of and familiarity with the relevance of climate variability and climate change to planning and decision making on public lands; 2) to understand how scientific or technical information for adaptation are currently being used, or what might be needed; and 3) to investigate how staff in federal lands field offices perceive legal, policy, and budget barriers that limit adaptation options. Researchers intend to use a pilot group of federal land managers to develop and test a survey that would permit quantitative analysis across respondents and provide qualitative data to identify unique circumstances and factors affecting decisions and information needs.

Contact: Lisa Dilling, CIRES and Center for Science and Technology Policy Research, lisa.dilling@colorado.edu



Native Communities and Climate Change: Supporting the Integration of Tribal Climate Change Information into National Decisionmaking Processes

Julie Teel is building on existing work supporting American Indian tribes and climate adaptation with a new project aimed at identifying the information available regarding (1) the impacts of climate change on American Indian tribes; (2) tribal climate response strategies, adaptation activities, and related planning efforts; and (3) federal laws and policies that support or inhibit these efforts. The project will also investigate how can this information be made widely available and integrated into the National Climate Assessment process.

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